The Politics of European Collaboration in Big Science

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Abstract Intergovernmental collaboration in Big Science has been an important resource for European science since the 1950s, as a means to compete on global level. But interestingly, collaboration in (basic) science has traditionally been left outside of the political integration work of the European Community/Union, which has resulted in a cluttered policy field and a situation where European Big Science collaborations are built on ad hoc solutions rather than a coherent political framework and common regulatory standards. Despite this formal detachment, however, the genesis and development of collaborations, and their political realities once launched, often draw upon and reflect the ordinary (geo)political dynamics of Europe. This chapter reports on four historical and two contemporary cases of European collaboration in Big Science, from CERN in the 1950s to the currently planned European Spallation Source (ESS), all well-documented by previous studies, showing that while scientific and technical preconditions doubtlessly impact the fate of these Big Science installations, the logic and cycles of high-level politics in Europe always plays a role and can, in some cases, be said to have been decisive for the realization of a collaborative effort. Always balancing between national interest and the common good, European collaboration in Big Science is thus no different from the process of EC/EU integration, despite being formally detached therefrom. Using a historical perspective to make justice to the rather small collection of cases to study, the chapter covers a distinct instance of where science and technology is directly affected by international politics.

Keywords Big Science • CERN • Common market • European Atomic Energy Community (EURATOM) • European Organization for Nuclear Research • European Union • Franco-German entente

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1 Introduction

The end of World War II marked the beginning of a new era in science and science policy, characterized by heavy governmental investment in R&D and institutionalization of the doctrine that science and technology has a major role to play in national defense, development and global competitiveness. A most manifest materialization of this "Marriage between science and the state", as journalist Daniel S. Greenberg (1999/1967) put it, was Big Science—enormously capital intensive complexes at the intersection of fundamental science and military R&D that became the subjects of an Arms Race of its own and signs of strength in the global East–west competition.

In Western Europe, the growth of Big Science was conditional upon the willingness of European governments to cooperate. The resurrection of European science after the devastating war required direct scientific competition with the United States and eventually the Soviet Union, Japan and China, and the road thereto required mobilization of resources beyond that of the European nation states. In the several decades to come, collaborative efforts resulted in the creation of joint organizations, laboratories and centers serving science in a variety of areas, among them science requiring large and costly instrumentation, the topic of this chapter. Interestingly, European collaboration in science did not form part of the mainstream Western European political integration process within the EC/EU project but remained, for the whole twentieth century, an area of formally uncoordinated ad hoc solutions and a myriad of different organizational forms and legal arrangements. In effect, this has meant that each new collaborative initiative have had to rely on the political will of the collaborating countries at the specific time of their genesis and development, which paradoxically enough has made European collaboration in Big Science a mirror of the cycles of European integration in the second half of the twentieth century and beyond.

In this chapter, the history of six collaborative European Big Science projects (two of which are in the making) is reviewed. Analyzing the political processes by which they have come into being, the chapter displays the connection of each of them to particular political/diplomatic conditions at the time of their birth and realization. Big Science is in this context taken to mean large scientific facilities that require a single location and whose realization, for financial/political and/or legitimacy reasons, require the collaboration of at least two European countries agreeing on governmental level. In Table 1, the facilities under study are listed, along with some basic information.

The chapter is structured as follows. In the next section, some fundamentals on the political realm of European intergovernmental collaboration in science are presented. Thereafter, brief historic accounts of the six cases in question are presented along with descriptions of the political embeddedness of the projects and highlights of some specific areas of political sensitivity that have been at the center of the negotiations over projects over the years. A final section summarizes

Table 1 The six cases

Facility	Location	Year of first conceptual idea	Year of start of operation	Type of facility	Number of member countries (at start of operation)
European Organization for Nuclear Research (CERN)	Geneva, Switzerland	ca 1950	1954	Nuclear physics/ high energy physics (accelerators)	12
European Southern Observatory (ESO)	La Silla, Chile/ Garching, Germany	1954	1966	Ground-based astronomy (telescopes)	6
Institut Laue-Langevin (ILL)	Grenoble, France	ca 1965	1972	Neutron scattering (reactor)	2
European Synchrotron Radiation Facility (ESRF)	Grenoble, France	1975	1994	Synchrotron radiation (accelerator)	12
European X-ray Free Electron Laser (XFEL)	Hamburg, Germany	ca 2002	2016[a]	Free electron laser (accelerator)	
European Spallation Source (ESS)	Lund, Sweden[b]	ca 1993	ca 2020[b]	Neutron scattering (accelerator)	

[a]Planned
[b]At the time of writing, the ESS is not formally approved/funded

the findings and the argument, and discusses some specific issues of interest in greater detail.

2 The Politics of European Scientific Collaboration

The 1951 Treaty of Paris, establishing the European Coal and Steel Community (ECSC), marked the beginning of formal postwar political integration in (Western) Europe. The ECSC was the first supranational organization on the continent and the first step towards a common market; its overarching goal was clearly to prevent future wars between foremost France and (Western) Germany but the concrete mission and purpose for the organization was to promote economic prosperity by rationalizing the production and sale of the vital raw products coal and steel. Thus restricted, very practical, and economically oriented, neither the agreements of the Paris Treaty nor the resulting ECSC had any elements of collaboration on the R&D side (Middlemas 1995: 21–22). The 1957 Treaties of Rome, establishing the Common Market as well as the European Atomic Energy Community (EURATOM), instructed member countries to collaborate on very specific areas: coal, steel, agriculture and atomic energy. No collaborative mandate was given in the area of science and technology outside nuclear energy, and EURATOM was furthermore subject to a separate treaty that did de facto not form part of the continuing European political integration process that eventually led to the Single European Act and the treaties of Maastricht and Lisbon.[1] Therefore, it was not until the 1970s that the realm of the European Community was extended to the promotion of science and technology, but then in the shape of industry-oriented programs launched to increase competitiveness in specific sectors, such as ESPRIT (for microelectronics and robotics) and the other various efforts within the so-called Framework Programmes (Grande and Peschke 1999: 45; Papon 2004: 69–70). Active partaking of the European Commission in maintaining and developing a broad research base in Europe began only several decades later, with the most recent Framework Programmes and the creation of a European Research Area (ERA). Nowadays, Framework Programmes funding is available also for initial planning of infrastructure projects, and a strategic body is in place to inform planning and decisions of both collaborative and national research infrastructure projects (Hallonsten 2012: 302–303), but for the whole of the twentieth century, the EC/EU stayed out of (basic) science.

Hence, while the necessity for Europe to collaborate in some sciences to compete on a global scale was acknowledged at an early stage, no political frameworks were put in place to create coherence and establish precedence across disciplines and technologies, and the projects that have been launched have therefore been dependent on ad hoc solutions and the recurring reinvention of legal arrangements and organizational structures. Big Science facilities of this kind are almost always conceived within scientific communities as answers to specific (scientific) needs, and then brought to political level by aggregated scientific lobbying efforts. The ultimate realization of a Big Science project is, naturally, the result of negotiation between these scientific interests and political priority-setting. The cutting edge character of Big Science facilities—mandated by the size of investments—typically makes the scientific side of their realization a complex and challenging process with parallel and interrelated tracks of formulating a credible scientific case, mobilizing a competent user community, and technological design and development at the cutting edge. On the other hand, national political systems typically have well-established procedures and institutions (e.g. systems of national laboratories, and political decision-making processes) for handling initiatives, set priorities between competing projects, and realize them politically (Hallonsten and Heinze 2012). In the case of these European collaborative projects, however, the political side of their realization appears just as messy and complicated as the scientific and technological, involving a vast and complex assortment of political agreements and negotiations on a variety of levels. If successful, this political process leads to the signing of an intergovernmental agreement, sometimes

[1] After some initial alleged troubles, EURATOM evolved into a parent organization for nuclear energy and thermonuclear fusion energy research activities including research but only in these distinct areas (Papon 2004: 64–65; Grande and Peschke 1999: 45).

comparable with an international treaty and sometimes establishing a private company with the member countries as shareholders, whereby the collaboration is founded. The variations with regard to the process and the eventual legal agreement are almost as many as there are collaborations; new shapes and forms have emerged for almost every new project.

Some analysts have named this lack of coherence a factor for the relative success of those collaborations that have succeeded, since it has arguably prevented bureaucracy and institutional inertia to take hold and created dynamisms and efficiency by allowing every specific project to meet the demands of its particular scientific community, at a specific time (e.g. Hoerber 2009: 410; Gaubert and Lebeau 2009: 38; Papon 2004). But the incoherence and lack of framework has also created an unnaturally composite system and an opaque and cluttered policy field where is seems impossible to avoid typical pitfalls and repeated exposure to political strains within and between individual European countries. Countries normally partake in collaborations not as an activity separate from national science policy agendas but rather, from the perspective of an individual country, as "the pursuit of one's interests by other means" (Krige 2003: 900). Most countries realize that collaboration is necessary to achieve goals beyond the reach of any one of them, but strong traditions of sovereignty create constant tension between self-interest and common good, for every partaking country, in every collaboration. In practice, his conflict shows itself in each instance where the relative gain of each (prospective) member country, and the (prospected) ratio between effort and benefit, is on the table. From the perspective of a prospective member country, the decision to participate is therefore perhaps best described as a multi-track cost-benefit analysis, where several possible gains and losses (economic, political, diplomatic, reputational) weigh in but where it would appear that every country in the end will simply seek to maximize its net gain. Whether this is at the expense of others, or coincides with the promotion of the common good and the health of the collaboration as a whole, seems to be a function of several variables and an empirical question, which is a main purpose of this chapter to respond to.

In the planning phase, the issue of site-selection is typically the trickiest, along with the question of the relative financial contributions and the policies for scientific access and procurement of goods and services. Typically, once agreements are made, the signed documents are legally binding, which means that (dis)agreements in the planning and negotiation phase are institutionalized in the facility and let to influence its organizational, technical and scientific performance. These areas of conflict show themselves to varying degrees in the six cases discussed below. The contextualization provided above and the unique scientific, technological and political aspects of a very limited number of cases would probably imply that each collaboration rather constitutes a unique response to a unique historical situation. While this is true, the underlying assumption of the chapter is also that those general patterns that are distinguishable, despite the expectable political and scientific uniqueness of coming collaborations, can and should be analyzed and eventually used as a battery of experiences that might assist policymakers in their quest to avoid pitfalls.

3 The Cases

3.1 *The European Organization for Nuclear Research (CERN)*

In 1954, the first multilateral European collaboration in Big Science was launched as an international treaty organization. Its overarching political logic was the enormous importance and impact of atomic energy for the ending of World War II, which had made nuclear physics a top priority of most governments, the realization that a joint scientific laboratory would be a favorable foundation for the tedious work to achieve political integration in Europe after the war, and the 'Marshall Plan for Science', i.e. the United States' efforts to assist the rebuilding of Western Europe in accordance with its geopolitical preferences (Krige 2006: 57–67; Krige 2014). CERN was created to complement national nuclear physics programs rather than replace them, and the cost of particle accelerators was still on the level of millions rather than hundreds of millions of dollars, which certainly helped in making CERN a largely uncontroversial feature of European science (and politics) (Pestre 1990: 785). Clearly, its political ramifications in the first decade of existence were straightforwardly simple: a peace project, mobilizing European competitiveness in science, and strengthening the ties to the United States.

This changed dramatically in the 1960s, when the international development in particle physics called for expansions of CERN to keep up in the competition with the United States and the Soviet Union (see, e.g., Greenberg 1999/1967). The proposed upgrade program was large enough to give rise to plans for a new, separate laboratory under the name 'CERN II', possibly located at a new site on the European continent. The very fact that another country could become the host (and thus prime beneficiary) of this large joint investment made member countries openly subjugate the collaboration to their own national interest, and nearly all proposed their own sites. The Federal Republic of Germany and the United Kingdom went as far as issuing ultimatums that they would withdraw completely from the collaboration should the new lab not be located within their borders. An attempt to choose a site on so called "scientific" grounds, i.e. by the work of an independent and "objective" expert committee was buried (Pestre 1996: 73, 77–78). In 1970, the situation was resolved by a decision to build CERN II at the existing site in Geneva. As a compromise solution, also reducing the costs of the project significantly, this apparently convinced member states to go along (Krige 2003: 905).

The reasons for the rupture over CERN II are multiple—significantly higher costs compared to the original CERN laboratory, waning enthusiasm towards big technoscientific projects among the member countries, and fears that CERN would monopolize national science budgets[2]—but overshadowing all was the looming end

[2] A fear that would prove true: CERN II did in fact become the only center for experimental particle physics in Europe, with the exception of the German laboratory DESY in Hamburg (see below).

to the protracted postwar economic boom and the relative political instability on the continent in the late 1960s.

3.2 The European Southern Observatory (ESO)

Before the European economic wonder and technoscientific enthusiasm faded, CERN would be accompanied by yet another big collaborative facility project. Already in 1954, the year of the founding of CERN, leading astronomers from six European countries had issued a statement and recommendation that their home countries embark on a project to establish a joint ground-based observatory. Scientific considerations had the project predestined for the Southern Hemisphere, and originally South Africa (Blaauw 1991: 5), which meant that the European Southern Observatory (ESO), as it would be named, was spared from all potential difficulties associated with choosing a site within Europe.

But ESO was to have its delays anyway. The fact that astronomy "lacked the aura of the nuclear" and was "remote from any practical use" made ESO "bereft of any broader industrial or local, national or global political considerations" which seems to have caused vulnerability for the project, since it made the question of participating a purely financial issue for each member country (Krige 2003: 906). This isolation from a broader policy context may be what caused Britain to hesitate and withdraw from the ESO project in the summer of 1960, in favor of a Commonwealth ground-based astronomy project in Australia (Krige 2003: 906; Blaauw 1991: 8–9), but British general euroskepticism is also a plausible factor. The other member countries (Belgium, Denmark, France, the Federal Republic of Germany, the Netherlands, and Sweden) managed to agree on the financing of the project, but still it could only become reality by a private donation from the Ford Foundation, whose contribution of $1 million eventually had the effect of "pushing the project financially over the threshold" (Blaauw 1991: 11). Between 1963 and 1967, the six member countries ratified the convention one by one, and the signing of France in 1964, which meant that 70 % of the funding was secured, gave effective go-ahead for the project (Blaauw 1991:18). By then, scientific considerations and the diplomatic work of the ESO provisional director Otto Heckmann had caused the change of preferred site from South Africa to Chile, where ESO was subsequently built, opening its first telescope for European astronomers in 1966 and run as an international organization (Krige 2003: 906).

3.3 The Institut Laue-Langevin (ILL)

The Institute Laue-Langevin, an reactor-based neutron scattering facility located in Grenoble, France, was founded in 1967 as a French private company on basis of a bilateral agreement between France and Germany that reflected the strong scientific ambitions of both these countries at the time while not exhibiting the typical quandaries of multilateral collaborations in Europe. Especially Western Germany, doubling its total R&D expenditures between 1962 and 1971, was on a path of investing heavily in both domestic and international large facility projects in the late 1960s, and the ILL was one of them (Trischler and Weinberger 2005: 64). The scientific initiative to the project, and the work to mobilize scientific support for its realization, is attributed to professors Heinz Maier-Leibnitz and Louis Néel, and indeed, it is often claimed that the ILL during its approximately four decades of operation has managed to maintain world leadership in the sciences it serves, hosting hundreds of experiments annually and contributing significantly to the development of neutron scattering techniques for wide utility areas in various parts of foremost materials sciences but also the life sciences (Herman 1986: 141; Tindemans and Clausen 2003).

But the ILL project also had its share of politics. The 1960s was a challenging time in the advances of Britain's relations with mainland Europe's integration process, and the British participation in ILL was consequently postponed until a new attitude towards European collaboration had taken hold in the UK (Judt 2005: 292, 526). That the ILL became reality at all, in 1967, was allegedly helped significantly by the signing of the Élysée Treaty 4 years earlier by German chancellor Konrad Adenauer and French president Charles De Gaulle. The creation of the ILL was not a direct part of the treaty but undoubtedly benefited greatly from the reconciliatory and cooperative sentiment it produced. The location in Grenoble is attributed to cheap electricity and colocation with French atomic energy agencies (Hallonsten 2012: 303).

3.4 The European Synchrotron Radiation Facility (ESRF)

In bright contrast to the strains to European collaboration characterizing the 1960s, the decade thereafter was marked by a general wave of renewed Europeanism centered on the entente between France and Germany that became the historically important "motor of Europe" driving the development towards the Maastricht Treaty and eventually the European Monetary Union (Middlemas 1995). In science, the 1970s and 1980s saw the creation of a number of collaborative organizations,[3] among which perhaps the European Synchrotron Radiation Facility (ESRF) is the most successful example.

Synchrotron radiation is extremely intense electromagnetic radiation produced by circular particle accelerators that, after use in solid state physics since the early 1960s grew rapidly in the 1970s as a technique for a wide variety of studies of

[3] European Science Foundation (ESF) in 1973, the European Molecular Biology Laboratory (EMBL) in 1973, the European Space Agency (ESA) in 1975, and the fusion research center Joint European Torus (JET) in 1977, to name a few (Herman 1986: 150–159; Krige 2003: 899).

materials, including life science applications. The expansion warranted initiative on European collaborative level to secure the supply of synchrotron radiation for European science, and in 1979, a feasibility study was presented by the European Science Foundation (ESF), outlining a collaborative facility that would both complement and supersede national European synchrotron radiation sources in performance (Hallonsten 2012: 305). With no financial or political powers, the ESF had to limit itself to efforts in mobilizing scientific support and mounting a lobby effort to win the support of politicians. Quite naturally, the location of the facility became a problematic issue already at the early stages, and several countries proposed their own sites. A 'scientific' site selection procedure, evaluating proposals on objective criteria, was launched. Nothing decisive happened, however, despite the rather generous pledges of financial support issued by some countries as part of their site proposals.

On 26 October 1984, France and Germany announced their joint decision to build the ESRF in Grenoble and together provide between 50 and 70 % of the construction costs of the facility. Other countries were invited to join. While causing surprise and resentment among the prospective collaborating countries, who felt run over by the two big nations, this decision by the government of France and Germany can in retrospect be identified as the most crucial event for the realization of the ESRF. It is probably no coincidence that it came the same year as the First European Framework Programme for Research and Technological Development (FP1) was launched, and the year before the signing of the Single European Act—the ESRF decision was likely a mere piece in the jigsaw puzzle of Franco-German partnership and renewed Europeanism in this era. The ESRF itself has later been identified as the "second prize" in the package deal between the two countries that also located the European Transonic Windtunnel (ETW) facility to Cologne (Papon 2004: 64; Hallonsten 2012: 314).

The other prospective member countries gradually accepted the Franco-German proposal, and negotiations over budget shares ensued. These mirrored much of the geopolitical situation in Europe in the late 1980s: The United Kingdom, expected to contribute considerably to the ESRF due to its strong scientific communities in fields utilizing synchrotron radiation, got away with a mere 14 % after harsh negotiations. French officials, alluding to past Italian vigor at a time when the Italian economy was in free fall and its government thirsty of (symbolic) restoration, allegedly managed to persuade Italy to pay more than was perhaps motivated (Hallonsten 2009: 220–221).

Construction of the ESRF started in 1989, and in September 1994, the facility opened for users (Hallonsten 2012: 305). The ESRF, run as a French private company, is generally considered a world-leading synchrotron radiation facility, exhibiting particular strength in output in relation to investment as well as high quality in technical and scientific assessments The most often mentioned reason for the strong showing is the comparable generosity of the funding portfolio for ESRF that has enabled the facility to move fast and invest in new areas of utility as they emerge and become popular in scientific communities (Hallonsten 2009: 232).

3.5 The European XFEL

The German research center DESY (Deutsches Elektronen-Synkrotron, German Electron Synchrotron) was among the very few national centers of particle physics left in Europe after the monopolization of particle physics budgets by CERN II in the 1970s. Also undertaking some work in synchrotron radiation, DESY was the main force behind the proposal in the 1990s to build a next-generation linear accelerator for particle physics named TESLA (Terra-electronvolt Energy Superconducting Linear Accelerator), combined with a 'next generation' x-ray source in the shape of a free electron laser. The German Federal Ministry for Education and Research showed greater interest in the free electron laser than in the TESLA machine, arguably not only looking at its smaller price tag but also following global trends of diminishing support for particle physics in favor of more application-oriented big science (e.g. Hallonsten and Heinze 2012). Consequently, in February 2003, the German Federal Ministry for Education and Research announced its plans to go ahead with the XFEL as a European facility located in Hamburg, and to cover for approximately half of the construction costs (Hallonsten 2012: 306). In 2004, France, Greece, Italy, Spain, Sweden, Switzerland and the UK signed a Memorandum of Understanding, and in 2005, the project was joined by China, Denmark, Hungary, Poland and Russia. Meanwhile, the technical design of the facility was given substantial updates but in 2007, funding was still not secured beyond the money already pledged by the German government. In October 2007, Russia announced its level of participation, 23.1 % of the construction costs, which was greeted by XFEL management as a "breakthrough" and "turning point", effectively securing the funding of the project but also empowered Russia with a de facto veto right on issues such as policy decisions regarding access (Hallonsten 2012: 306).

The Russian €250 million contribution to the XFEL is said to have been the result of a high-level agreement between German chancellor Angela Merkel and Russian president Vladimir Putin, made at a summit meeting in October 2007 that was otherwise described as a "cold encounter" ("Kühle Begegnung", Kirschstein 2007), and thus constituting a much-needed symbolic act of unity in the otherwise very tense relations between the countries (Hallonsten 2012: 306), or, as Krige (2003: 904) has put it, "just because it is seen as being a 'non-political' activity, scientific collaboration can be a particularly useful first and tentative step in a politically delicate context of alliance building".

The construction of the XFEL is underway since 2010, under the rule of a German private company, and it is estimated that the first part of the facility can be taken into operation in 2015 (Hallonsten 2012: 306).

3.6 The European Spallation Source (ESS)

The most recent large collaborative facility project in European science is the perhaps most delayed in history, now entering its twentieth year under the name the European Spallation Source (ESS) but yet without binding legal agreements on funding and organization of the project.

Accelerator-based spallation facilities are supposed to deliver enhanced performance to neutron scattering research of the type conducted at e.g. the ILL, and they are nowadays seen as largely complementary to synchrotron radiation and free electron laser facilities. Plans for a European spallation facility were drafted already in the early 1990s, but didn't get any political leverage until almost a decade later, when made part of recommendations for large-scale scientific projects by the Organization for Economic Cooperation and Development (OECD) together with similar projects in Japan and the USA (Kaiserfeld 2013). Work on the Japanese and American facilities promptly began, but even at the time of their completion some 7 years later, Europe still had not reached any decisions. Site contenders had come and gone, Germany and the UK had both declared interest and later withdrawn, and a meeting in Bonn in 2002, supposed to settle the issue and initiate an active phase for the realization of the project, had ended with "a kind of acceptance that it is never going to happen" and effectively buried the project (Berggren and Hallonsten 2012: 24–28; Hallonsten 2012: 307). At the end of 2008, when the cabinet level EU Competitiveness Council took up the issue, three site contenders remained—Lund in Sweden, Bilbao in Spain, and Debrecen in Hungary, all in the midst of an intense political lobbying campaign for their facility proposal (Kaiserfeld 2013). At a meeting in Brussels on 28 May 2009, representatives of countries that had declared interest to participate in the ESS decided that the Lund site would be the preferred choice for the ESS facility. However, the decision came with no financial guarantees, and despite the message in local media and elsewhere that the ESS has been decided upon and will be realized, the outcome of the May 2009 meeting was nothing more than an agreement that *if* the ESS is build, it will be built in Lund (Hallonsten 2012: 307).

As the most recent, and yet not formally approved, European collaborative facility project in science, the ESS is still subject to far-reaching secrecy and the political process of its creation is largely shrouded in mystery. Sweden and Denmark, so far the only shareholders in the ESS company, have pledged to cover approximately 50 % of the construction costs but announced a significantly lower commitment to the eventual financing of the operation of the facility. Thus after 20 years of planning, and almost 4 years after the 'decision' in favor of the Lund, Sweden, site, there are still little signs of an imminent go-ahead decision for the project. Considering the current economic situation in Europe, this might warrant some disillusionment when it comes to the prospects of an ESS facility actually becoming reality.

4 Discussion

While the six cases presented are all scientific user facilities and the products of multilateral European agreements on governmental level, they obviously also differ significantly in character. It is plausible that a common legal framework, developed within the EC/EU, and some precedent in treaties and formal agreements *could have* created greater coherence among the facilities and arguably also reduced uncertainties in preparatory work to the extent that some delays and disagreements could have been avoided. The case of the United States, where Big Science installations are almost exclusively built and operated within the National Laboratories system and where there is greater coherence in the organizations of Big Science labs despite great differences in their science missions and their time of creation (Hallonsten and Heinze 2012), supports such a speculation. Clear is that each and every European facility project described above has had to come into being on basis of ad hoc solutions, which is part of the explanation of their dissimilarity. This is also what provides the foundation for the contribution of this chapter: incoherence and discontinuity in politics of facility projects have made these projects prone to adopting and incorporating other more general trends in European politics at the times of their realization.

The political forces behind the creation of CERN are rather easy to identify. Not only is CERN enormously well documented (e.g. Hermann et al. 1987, 1990) but also a piece of folklore in the modern history of science: The postwar policy of the United States to secure its influence in Western Europe, the first wave of Europeanism after the war, and the general nuclear euphoria at the time seems to have sufficed for guaranteeing the success of almost any project connected to nuclear physics. At least it sufficed for CERN.

The 1960s was a period of strains in the European collaborations, most evidently so between Britain and the continent, showing in ESO, ILL (at first) and in the CERN II controversy. A similar euroskepticism characterizes current British foreign policy, which links well to the decline of UK to join both the ESS and the XFEL. In between, Britain agreed to participate in the ILL and the ESRF, however in the latter case with reluctance to contribute on par with its scientific and economic strength. This stance did not delay the project in itself—by the mid-1980s the shift of the locus of Europeanism to the Franco-German relations appears to have been strong enough to overcome most other political obstacles. The ESRF, on many accounts the world's most successful synchrotron radiation facility (Hallonsten 2013), still rides on the Franco-German entente of the 1970s and 1980s.

There is little hard evidence for the claim that Russian participation in the European XFEL project was determined by a need for a reconciliatory move between Russia and Germany, but in historical light the claim seems plausible. Fortunately for the XFEL project, a convention was signed, and funding pledges made, before the outbreak of the financial crisis and the subsequent Euro crisis. The European Spallation Source (ESS) did not have that fortune, and the deepening crisis in the European economy is one possible explanation for the fact that 4 years after the 'decision' in favor of Lund, Sweden, no legally binding agreement and/or funding plan has been presented.[4]

A few other topics on the level of details of the politics of the collaborations deserve mentioning. Troubles in connection with site selection have been mentioned a couple of times, and these troubles have generally been due to ample expectations of socio-economic benefits brought to the host country and region by an international research facility, in addition to potential benefits for the local scientific community and the risk of disadvantages of not hosting. This is, in other words, an incarnation of the basic tension between national interest and common good that always plague European collaboration (cf. Krige 2003). In the cases discussed, the issue of site selection has been resolved either by a kind of default solution or by politics. CERN II ended up in Geneva, at the original CERN site, as a compromise. The ESO was predestined for outside Europe and was spared from conflict over location. ILL had only two partner countries at the time of its launch and economic factors were allowed to rule. ESRF was a piece in a larger game between France and Germany, which also settled the matter of location. In contrast to ESO, the XFEL's predefined site in Hamburg seems rather to have been a liability to the host country, because other countries appear to have less interest in participation if the site is already agreed upon. And for the ESS, it is not a stretch too far to claim that Sweden could emerge as winner only after Germany and the UK had withdrawn their site bids. Generally, it seems site-selection is a key piece in the negotiations and lobbying that produce European collaborative Big Science projects. A clear lesson from history, for policymakers to build future efforts on, is that it is only after a viable site has been agreed upon that the real conditions for the process of realization of the project in question are enough known and countries can start evaluating what their level of commitment should be.

But also after a site has been decided upon and the finances secured, struggles over investments and benefits continue. A mechanism put in place to counter the imbalance effects of investment and return that may make hosting of a facility a major economic boost for the local region is so called *Fair Return* (or *Juste Retour*) on procurement, applied in all collaborations under study here, and essentially securing that the collected value of contracts awarded to firms in a member country on long term reflects that country's relative contribution to the budget. An interesting political reality facing coming collaborations such as XFEL and ESS is the apparent illegality of Fair Return under the rules of the common market of EU (Leonard 2010), and new policies have hence been invented to secure return for investment for collaborating countries. Most extensive is the use of *in-kind contributions* by member states, which is the opportunity for member countries to substitute direct financial investment in a facility for the delivery of goods and

[4] Another contributing factor for this might be that the 'decision' was made without a complete technical design and scientific case for the facility. These have reportedly been under development since 2009, and only after their finalization will it be possible to set a price tag for the future facility, for the prospective member countries to negotiate over.

technology and thus spend their money domestically. The policy has some drawbacks; restricting the call for tenders to the participating countries might exclude competitive alternatives, and there is also a risk that at the time of delivery, which might be several years after the in-kind agreement was made, the best qualified company may no longer be in the country providing the particular in-kind contribution. Both the ESS and the XFEL projects will rely heavily on in-kind contributions—approximately half of the total investment, according to estimations (Hallonsten 2012: 309). The challenges associated with this seem new in historical perspective; perhaps lessons learned from the experiences of Fair Return can provide policymakers and lab administrators with some guidance.

The scientific use of a facility, so far unnaturally uncovered in this chapter, has also been the subject of Fair Return-like arrangements, most famously in the case of ILL and ESRF where the allocation of experimental time at the facilities is corrected after the ordinary peer review process to reflect nations' relative financial contributions (Hallonsten 2009: 244–246). In the case of XFEL, it seems the legal documents invite a similar policy to be implemented once the facility is in operation. There are signs that Russia, having obtained strong influence over the governance of XFEL by their large financial contribution (see above), intend to secure access to the facility for its domestic scientific community through the implementation of a strict Scientific Fair Return policy: The November 27, 2009 press release announcing Russia's signing of the XFEL convention stated that "beam usage time *will be* shared proportionally to each country's contribution to the project" (Russian Corporation of Nanotechnologies 2009, emphasis added). Clearly, Russia sees their participation in the XFEL project merely as "the pursuit of [their] interests by other means".

To Russia's defense, it could of course be reiterated that this is the normal procedure for European collaboration in Big Science; this is, furthermore, also a key lesson of this chapter that perhaps could instill some caution among those directly involved in setting up the scientific organization for the XFEL and other projects. One might indeed speculate, as Papon (2004: 70) and Hallonsten (2012: 311) does, that there is a re-nationalization trend in European scientific collaboration, showing itself in individual countries' increased guarding of national interest at the expense of the common good. Hallonsten (2012: 311) mentions a few recent signs of such a development, first Britain's and Italy's 2010 lowering of their contributions to ESRF, and then the apparent strategy of prospective member countries in the XFEL to enter at the lowest level possible, realizing that their influence in the collaboration will be marginal anyway, given the size of the shares of Germany and Russia. Arguing, on scientific grounds, for the abolition of Scientific Fair Return, these countries have even less of a reason to increase their contribution—their domestic scientific communities will have to compete scientifically for access anyway.

Combining the speculation of a re-nationalization trend with the other overall conclusion of this chapter—that European collaborative projects in Big Science tend to mirror the cycles of European integration and geopolitics—amounts to a rather gloomy realization. It should be emphasized that the argument here is not that high-level politics is the only deciding factor for the achievement of a Big Science collaboration in Europe, only that it seems politics trumps most other motives in the *final decisions*. In this perspective, and considering generally the history of Europe in the last 70 years, it is somewhat ironic if this re-nationalization is the overruling trend, given the success of European integration on other arenas. One would then perhaps be prone to refurbish one of the most famous quotes of the former President of the United States Bill Clinton: "It's the economy, stupid!"

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